Java – Inheritance

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Inheritance

- Reusability and extendability
- Super class and Sub class
- super key word

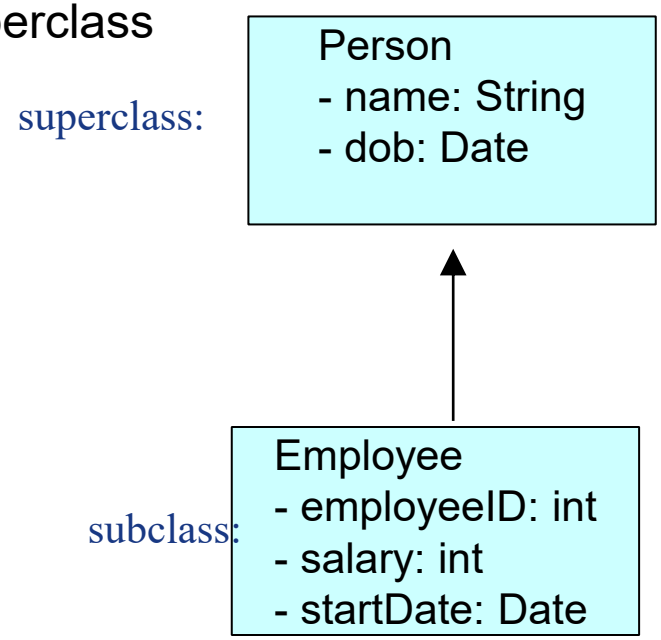
Terminology

A class can be defined as a "subclass" of another class.

- The subclass inherits all data attributes of its superclass
- The subclass inherits all methods of its superclass
- The subclass inherits all associations of its superclass

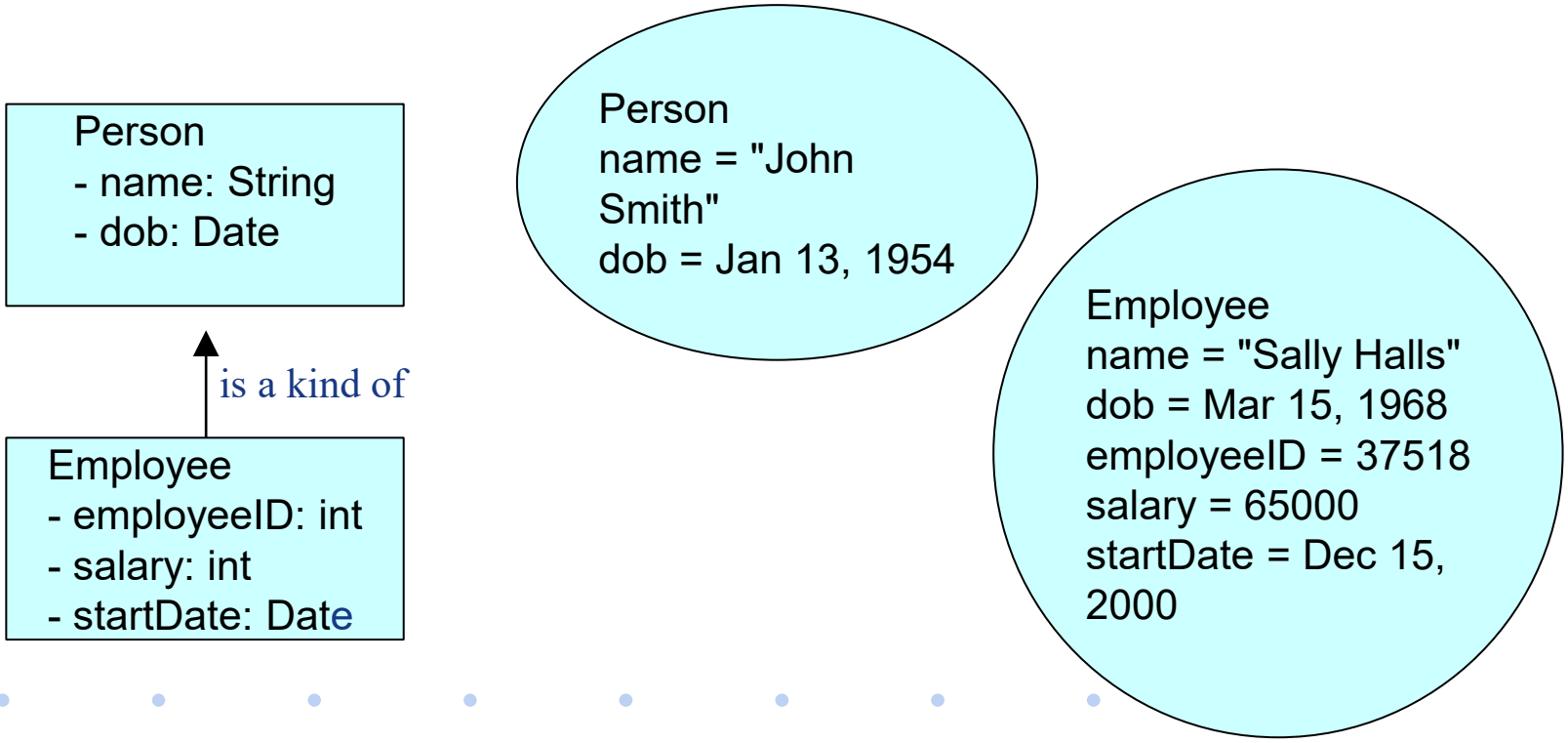
A sub class can

- Add new functionality
- Use inherited functionality
- Override inherited functionality



What really happens?

- An Employee object inherits all of the attributes, methods and associations of Person



Example

```
public class Person{
    private String name;
    private Date dob;
    ……
}
```

```
public class Employee extends Person{
    private int employeID;
    private int salary;
    private Date startDate;
    ...
}
```

```
Employee anEmployee = new Employee();
```

Design different objects

Method Overriding

- ***Method Overriding*** allows a subclass to redefine methods of the same signature from the superclass.

- The key benefit of overriding is the ability to define/defer behavior specific to subclasses.

- An overridden method must have:
  - The same name
  - The same number of parameters and types
  - The same return type or its subtype.

Method Overriding - Example

```
public class Product {

    private int productId;

    private String name;

    private double price;

    // Constructors, setters,getters and
    //other methods
        public boolean isExpensive() {
            return false;
        }
}
```

Television class overrides isExpensive() method of Product to define specific behavior of finding if Television is expensive or not.

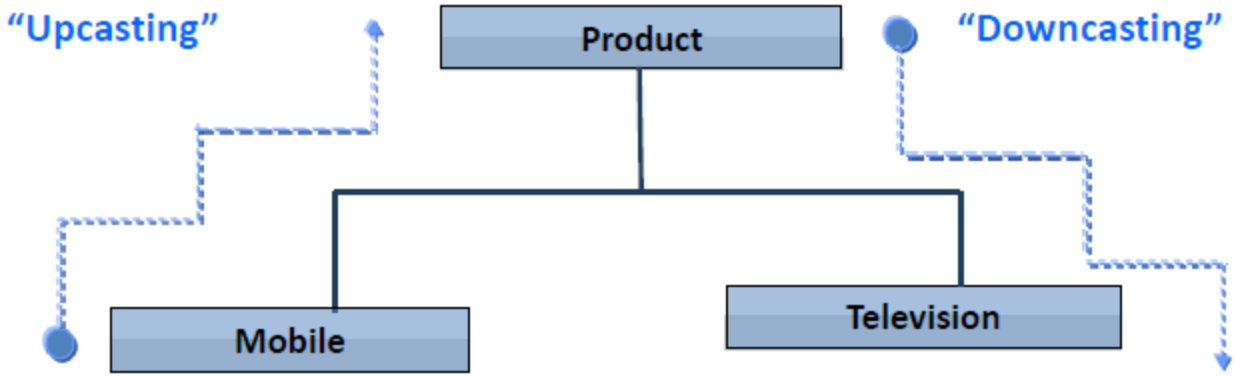
```
public class Television extends Product {
    private String screenType;
    private String screenSize;
     // Constructors, setters,getters and
     //other methods

@Override
public boolean isExpensive() {
      if( screenType.equals("CRT") &&
                  getPrice() > 20000.00) {
                  return true;
       } else if( screenType.equals("LCD")
            && getPrice() > 40000.00) {
                  return true;
       } else if( screenType.equals("LED")
            && getPrice() > 60000.00) {
            return true;
      }
            return false;
      }
}
```

Object / Reference Casting

- To upcast a Mobile object, all you need to do is assign the object to a reference variable of type Product.

```
Product product = new Mobile();          // upcasting
```

- `Mobile mobile = (Mobile) product;` // downcasting



Object Typecasting – Reference Casting

Given:

```
public class A {
        public void first(){
                System.out.println("First Method");
        }
        public  void second( ) {
                System.out.println("Second method");
        }
}
    public class  B extends A {
         public  void second(int data ) {  // overloading
                System.out.println("Second method with data");
        }
}
```

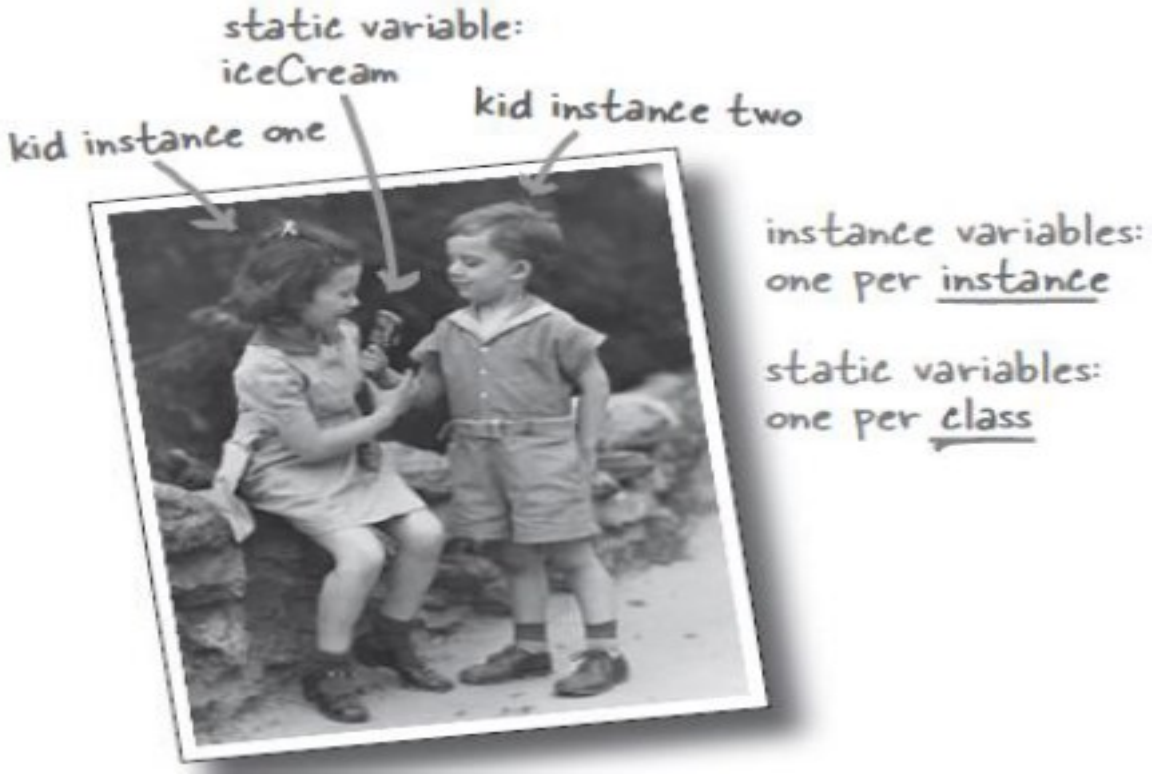
What is the output of running the following statements?

1)
```
A obj  = new B();
obj.second();
obj.second( 22 );
```

2)
```
B nobj = new B();
nobj.second();
nobj.second( 22 );
```

Static Members

- Static variables are shared by all instances of a class



Static Variable

```
public class Employee {
    private String name;
    private static int count = 0;
    public Employee() {
        count++;
    }
    public Employee(String name) {
        this.name = name;
        count++;
    }
    public String getName() {
        return name;
    }
    public static int getCount() {
        return count;
    }
}
```

The static count is initialized only once when the class is loaded and not each time a new instance is created

It will keep incrementing each time the constructor is called and won't be reset to 0.

Static Members

- Java is object-oriented, but once in a while you have a special case, typically a utility method (like the Math methods), where there is no need to have an instance of the class.
- The keyword static lets a method run *without any instance o/the class.*
- A static method means "behavior not dependent on an instance variable, so no instance/object is required. Just the class."
- Example:
- The following method declared in Math class is declared as static

```
public static int min(int a, int b) {
    return (a <= b) ? a : b;
}
```

```
Math.min(42,36);
```

Use the Class name, rather than a reference variable name.

Static methods in Inheritance

Example:

```
public class Animal {
        public static void testClassMethod() {
System.out.println("The class" + " method in Animal.");
        }
}
public class Cat extends Animal {
        public static void testClassMethod() {
        System.out.println("The class method" + " in Cat.");
        }
}
public static void main(String[] args) {
        Animal myAnimal = new Cat();
         myAnimal.testClassMethod(); --> Animal.testClassMethod();
}
```

- The output from this program is as follows:
  - The class method in Animal.

Static Members in Inheritance

- Answer this:

Given :

```
class A {
    public static void test() {
        System.out.println("test method of A");
    }
}

class B extends A {
    public static void test() {
        System.out.println("test method of B");
    }

}
```

What is the output?

```
A obj = new B();        // 1
obj.test() ;            //2
```

Access Specifiers

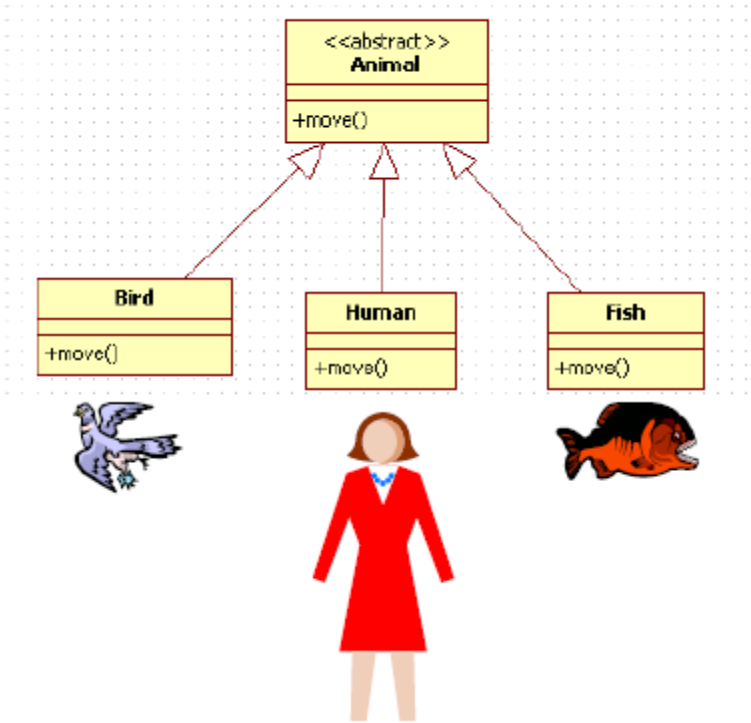
Visibility	Public	Protected	Default	Private
From Within the Same Class	Yes	Yes	Yes	Yes
From any class in the Same Package	Yes	Yes	Yes	No
From a sub-class outside the Package	Yes	Yes	No	No
From a non sub-class outside the Package	Yes	No	No	No

Final

- The final keyword can be used in many context.
  - Attribute
    - you cannot change the value once assigned [constant]
    - Example: public static final double PI = 3.14;
  - Method
    - You cannot override a final method
    - Example: public final Boolean login( ) {
  - Class
    - You cannot inherit a final class
    - Example: public final class String {

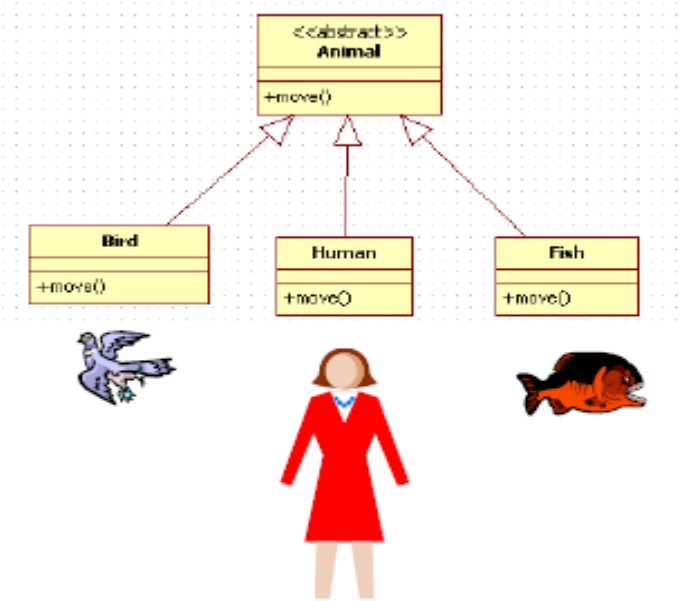
Abstraction – Abstract Classes

- If we create an instance as shown below:
  - Animal animal = new Animal();
    - How does this animal look like, what features does it contain.
    - What will be its instance variables values
- **Some classes should not be instantiated**



Abstract Class

- We need Animal class, for inheritance and polymorphism.
- We want programmers to instantiate only concrete subclass of Animal, and not Animal itself.
- We want Human Objects, Bird Objects, Fish objects,..



- By marking the class as abstract, the compiler will stop creating an instance of that type.

```
public abstract class Animal {
```

Abstract Methods

- An abstract method is an generic method which would be useful for subclasses.
- An abstract method has no body!
- An abstract method means the method must be overridden.

"All subtypes of this type have THIS method"

```
public abstract class Product {

    private int productId;
    private String name;
    private double price;

    // remaining code
    public abstract boolean isExpensive() ;

}
```

The method isExpensive( ) is made abstract because it is generic. We cannot provide logic in this method to find if product is expensive or not.

Concrete classes extending from Product [Television, Mobile, ..] will override this method and provide appropriate logic to find if its expensive or not.

Abstract Methods

- Any class which extends an abstract class has to override all abstract methods declared in super class, else that class should also be declared as abstract.
- This enforces all derived classes to provide a common signature [public boolean isExpensive()]

Television class overrides public boolean isExpensive() method which is declared abstract in Product class

```
public class Television extends Product {
   private String screenType;
   private String screenSize; // in inches

   @Override
   public boolean isExpensive() {
      //CRT Televison is expensive if cost is more than 10,000/-
      if( screenType.equals("CRT") && getPrice() > 20000.00) {
         return true;
      } else if( screenType.equals("LCD") && getPrice() > 40000.00) {
         return true;
      } else if( screenType.equals("LED") && getPrice() > 60000.00) {
         return true;
      }
      return false;
   }
```

Interfaces

- A Realization is a relationship between two elements, in which one element (the client) realizes the behavior that the other element (the supplier) specifies.
- Java interfaces are for realization relationship.
- Java interface is like 100% pure abstract class.

Interfaces …

- All interface methods are abstract , they must end with semicolon and contains no body

```
public interface Comparable {
    public int compareTo(Object object);
}
```

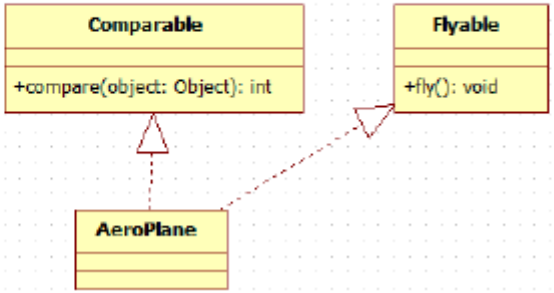
```
public interface Flyable {
    public void fly();
}
```

Interface Example

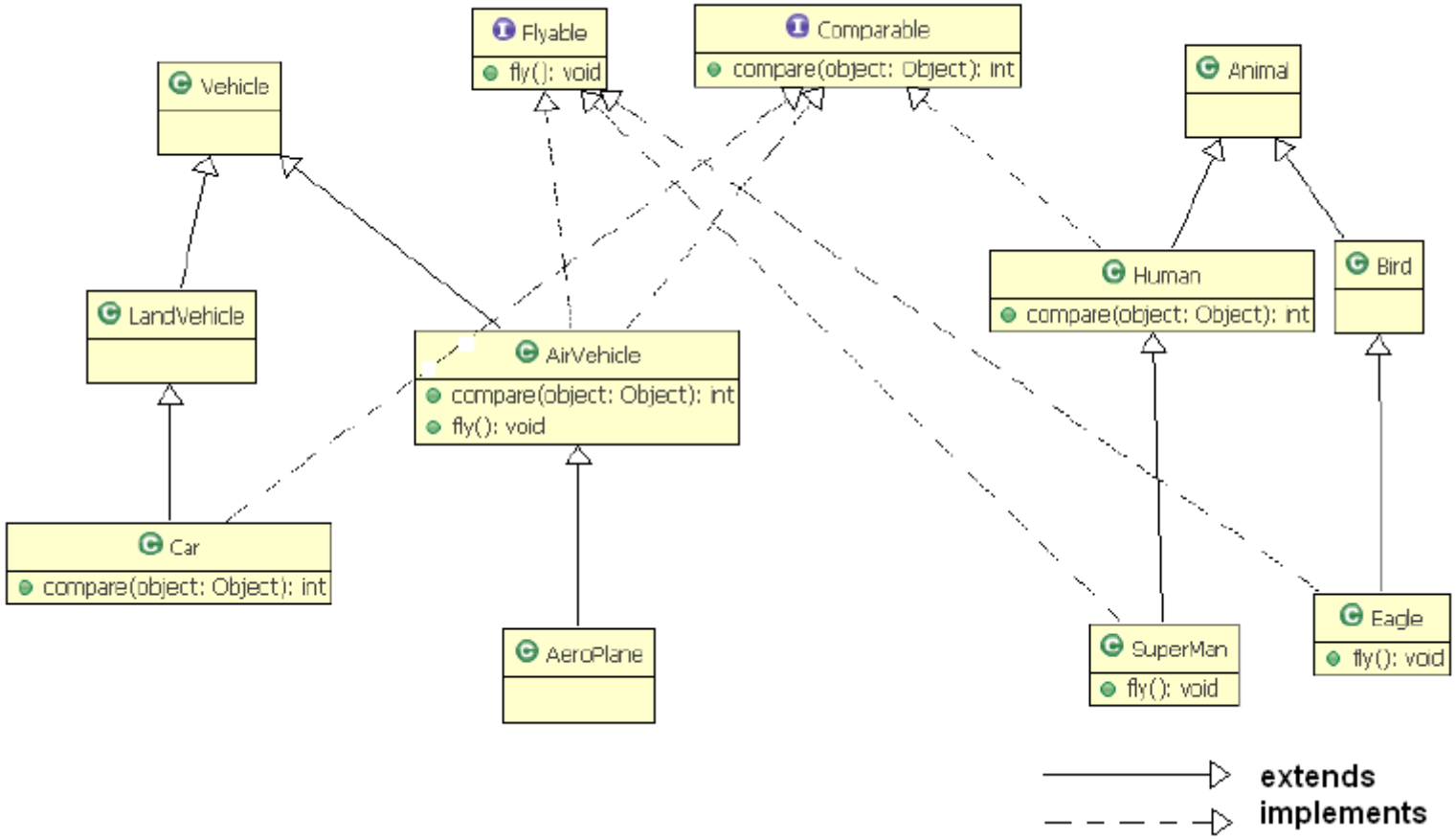
```
public class AeroPlane implements Comparable,Flyable {

    @Override
    public int compareTo(Object object) {
        int difference = 0;
            //remaining code
        return difference;
    }

    @Override
    public void fly() {
        // code
    }

}
```

Implement the method declared in Comparable as a contract

Implement the method declared in Flyable as a contract



Interfaces Relationship



Interface …

With reference to the UML diagram provided in previous slide:

Answer this

- Given a method signature as

```
public void doTask(Comparable first, Comparable second) {
    // code here
}
```

- If we create objects as shown below:
  - Human h = new Human();
  - Bird b= new Bird();
  - Car c = new Car();
  - Comparable sm = new SuperMan();

Which of the following options are valid?

1. doTask(h, sm);
2. doTask(b,c);
3. doTask(h,c);

Interface Extention

- You can add new methods to an interface by using inheritance, and you can also combine several **interfaces** into a new **interface** with inheritance.

```
interface Fight {
   public void fight();
}
interface Dance  extends Fight {
   public void dance();
}

class Actor implements Dance {

   @Override
   public void fight() {
         // fight implementation
   }

   @Override
   public void dance() {
      // dance implementation
   }

}
```

Dance is a simple extension of Fight!!!

Actor implements Dance, and hence he knows to dance and fight

Why Interface?

- **Design**: the methods of an object can be quickly specified and published to all affected developers.
- **Development**: the Java compiler guarantees that all methods of the interface are implemented with the correct signature and that all changes to the interface are immediately visible to other developers
- **Integration**: there is the ability to quickly connect classes or subsystems together, due to their well-established interfaces
- **Testing**: interfaces help in loose coupling between objects and hence help to isolate bugs.


return
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